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ures) Paleozoic column, and entered mica schist, which is regarded as Archean in age. Estimates from this boring give about 3,000 feet as the total thickness of the Paleozoic.

Microscopic Characters of the Fisher Meteorite (Minnesota No. 1): By N. H. WINCHELL. This meteorite fell in Polk County, in northwestern Minnesota, April 9, 1894. It is a chondritic stone made up largely of olivine and enstatite, and contains a comparatively small amount of iron. Two apparently isotropic substances occur in the meteorite, one of which may be maskelynite; but the conclusions concerning these substances and the chemical composition of the stone will be discussed in a later paper.

The number closes with the usual reviews and notes. Of special interest, however, is the review of Nordenskjöld's important paper on the Swedish hälleflintas, largely pre-Cambrian lavas. In this review are some interesting remarks concerning the devitrification of glass, and reference is made to some phenomena of devitrification recently observed at Bryn Mawr College.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON, FEBRUARY 29, 1896.

DR. J. WALTER FEWKES read a communication on the Prehistoric Culture of Tusayan. He regarded archæology as the only means of obtaining accurate knowledge in regard to the subject, and considered documentary history, study of surviving legends and modern practices as tributary and necessary sources of information. Archæological evidences of the character of ancient life in Tusayan were drawn from excavations at Sikyatki, a ruined pueblo near Walpi, which was investigated by an expedition sent out last summer by the Smithsonian Institution under the lead of the speaker. The material unearthed from this ruin was a large collection of pottery of rare excellence and many objects illustrative of prehistoric Tusayan industries.

The evidences that Sikyatki was overthrown previous to the coming of the Spaniards into Tusayan in the middle of the sixteenth century were discussed, and shown to amply prove that the pueblo was destroyed in prehistoric times.

The great value of the objects from this ruin was therefore held to be that they indicate prehistoric culture, without European influences. The ceramics of Sikyatki are far superior to modern Tusayan pottery, and excel in fineness of ware, symmetry of form and artistic beauty of decoration those of any aboriginal tribe of America north of Mexico.

The reason of the fineness of this ware and the possibility that coal was used in firing it were discussed. The identity of prehistoric and modern mortuary customs, as indicated by the objects taken from Sikyatki graves, was interpreted to mean a similarity of ancient conceptions of death and a future life. Current modern beliefs on this subject were discussed and applied to an interpretation of ancient customs.

It was held by the speaker that the symbolic designs on this ancient pottery should be considered a body of prehistoric picture writing or paleography, and that the aim of the student should be to interpret it. He likened this symbolism to ancient records, and claimed that from them could be obtained a knowledge of mythological conceptions and ancestral rituals. The pictures of several animistic and other gods still recognized in modern Tusayan mythology were instanced and compared with modern figures. This ancient pictography likewise shows the antiquity of peculiar methods of dressing the hair.

The resemblance of certain geometric designs to those on the pottery from the great ruins of the Gila valley and the cliff dwellings of the Mesa Verde was pointed out and the importance of such likeness discussed.

Dr. Fewkes spoke of a large number of mortuary prayer-sticks or pahos in Sikyatki graves, which he compared with modern and found a great conservatism in their form, size, color and appendages. He believed these resemblances meant a similarity in ancient and modern conceptions of the priests who made them. The existence of other ceremonial paraphernalia, identical with those still used in the modern Tusayan ritual, was likewise pointed out. A knowledge of modern mythology and ritual he regarded as necessary for anyone who would do good work on the archæology of the Southwest.

He showed that in prehistoric times the Tusayan people had Oliva shells from the Pacific Ocean and turquoises from New Mexico. They were ignorant of any metal, but were adepts in stone chipping and polishing. Fabrics were made from the feathers of the bluebird and eagle, and they had necklaces of cedar berries, turkey bones, with ornaments of lignite, selenite and mica.

He brought forward additional evidence to show the identity of cliff dwellers and ancient pueblos and considered that some of the cliff houses were inhabited when Sikyatki was in its prime. In closing Dr. Fewkes emphasized the poverty of material in museums from which we could draw evidences for speculations in regard to the derivation of prehistoric pueblo culture, and held that theorizing had far outstripped observation. While considering science piteously weak in data, he thought that no field offered more promising results to a serious student than the ruins of the Southwest.

The second paper was on *a new solution of the geodetic problem*, by CHAS. H. KUMMELL, of U. S. Coast and Geodetic Survey. This solution is based on the geodetic line. It requires therefore a reduction of the astronomical azimuth to the geodetic azimuth and, theoretically at least, a reduction of the astronomical latitude to the reduced latitude. An auxiliary spherical triangle is assumed, having the equation of the geodetic line for its sine relation, which is referred to that point as origin where it meets a meridian at right angles. The distance in arc of the first point from that meridian is denoted δ , that of the second $\sigma_2 = \sigma_1 + \Delta\sigma$. The arc σ_1 is easily computed, and $\Delta\sigma$ is found from a series of which only three terms are required even for the greatest intervisible distances. We have now in the auxiliary spherical triangle the sides $\Delta\sigma$, $90^\circ - \psi_1$ (complement of reduced latitude of first point), and included angle a_1 (geodetic azimuth to second point). We can find then by rigorous spherical trigonometry the parts a_2 and $90^\circ - \psi_2$ and hence also the astronomical back azimuth a_2 and latitude ϕ_2 . To attain the customary precision this would require ten-place logarithms. In order to reach the same accuracy with seven place logarithms formulæ are given for computing the

convergence of meridians $\Delta\alpha$ and difference of latitudes $\Delta\phi$. For $\Delta\lambda$, the difference of longitudes, two methods are given, one based on the geodetic line by computing $\Delta\lambda_0$, the angle opposite the side $\Delta\sigma$ and correcting this, by a term of the fourth order in eccentricity and first order in distance. The other method is by Dalby's theorem and is more convenient. A complete example computing the position of Königsberg from Berlin was exhibited, which showed the formulæ used as precise as the ten-place computation of the same example in Helmert's *Hoehere Geodäsie*. The method is claimed to be principally advantageous for the greatest intervisible distances for which e and $\Delta\sigma$ are nearly of the same order (they are equal at about 500,000^m). For secondary points $\Delta\sigma$ is much smaller than e and in that case Tables and Formulæ such as Woodward's Smithsonian Geographical Tables and those of the Coast Survey which go an order higher are preferable.

BERNARD R. GREEN,

Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

THE 115th regular meeting was held March 5, 1896.

Mr. Marlatt, under the title 'A Study of the Anatomy of Hymenoptera,' gave a comprehensive view of certain structural features of Tenthredinidæ, dwelling at length upon the homologies of the sclerites of the thorax.

Mr. Schwarz, under the head 'Notes From Southwestern Texas, No. 2,' spoke of a species of Termite which is found in great numbers throughout southwestern Texas, which burrows deeply under the ground and which is of great economic importance from the fact that during a large part of the summer it destroys all low-growing vegetation in large patches, rising from the ground and enclosing all portions of the plants with a tubular structure composed of grains of subsoil. The insect is probably the worst insect pest of southwestern Texas, on account of the damage which it does to pasture.

Mr. Ashmead exhibited a specimen of a new species of *Roctronia* of Provancher. The species in question comes from California, and by its aid Mr. Ashmead has decided that this genus be-

longs to the subfamily Helorinæ of the Proctotrypidæ.

L. O. HOWARD,

Recording Secretary.

NEW YORK ACADEMY OF SCIENCES—BIOLOGICAL SECTION, FEBRUARY 7, 1896.

Dr. J. G. CURTIS in the Chair.

A communication from the Council was received asking that the Section take action on Representative Hurley's bill "To fix the standard of weights and measures by the adoption of the metric system of weights and measures."

On motion of Dr. Dean the Section approved the bill, and the Secretary was directed to express the entire commendation of it to the Council.

Dr. Arnold Graf read a paper on 'The Structure of the Nephridiap in Clepsine.' He finds in the cells of the intra-cellular duct fine cytoplasmic anastomosing threads which form a contractile mechanism. These are stimulated by granules which are most numerous near the lumen of the cell, and thus a peristalsis is set up, which moves the urine out of the duct. In the upper part of the intra-cellular duct the two or three cells next to the vesicle or funnel have no distinct lumen, but are vacuolated; the vacuoles of the first cell being small, those of the second larger, and so on, till the vacuoles become permanent as a lumen. He explains the action of the first cell as being similar to the ingestion of particles by the infusorians. The matter taken up thus from the funnel by the first cell is carried by the rest, and so on till the cells having a lumen are reached. The presence of the excrement causes the granules to stimulate the muscular fibres of the cells; peristalsis results and the substance is carried outwards. The character of this contractile reticulum offers an explanation of the structure of a cilium as being the continuation of a contractile reticular thread.

N. R. Harrington, in 'Observations on the lime gland of the Earthworm,' described the minute structure of these glands in *L. terrestris*, and showed that the lime is taken up from the blood by wandering connective tissue cells which form club-shaped projections on the lamellæ of the gland, and which pass off when filled with lime. The new cell comes up from

the base of the older cell and repeats the process. This explanation is in harmony with the fact that in all other invertebrates lime is laid down by connective tissue cells. Histological structure and the developmental history confirm it.

Dr. Bashford Dean offered some observations on 'Instinct in some of the lower Vertebrates.' The young of *Amia calva*, the dogfish of the Western States, attach themselves, when newly hatched, to the water plants at the bottom of the nest which the male *Amia* has built. They remain thus attached until the yolk sac is absorbed. As soon as they are fitted to get food they flock together in a dense cluster following the male. When hatched in an aquarium they go through the same processes. The young fry take food particles only when the particles are in motion, never when they are still. The larvæ of *Necturus* also take food particles that are in motion.

C. L. BRISTOL,

Secretary.

NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Section of Astronomy and Physics held on March 2, 1896, the election of officers for the ensuing year was held, and R. S. Woodward was elected Chairman and W. Hallock Secretary.

The first paper of the evening was upon the device designed by Prof. W. L. Robb for showing the way in which a cord can vibrate, consisting essentially of an electro-magnet running a vibrating arm to the end of which the string is attached.

The second paper was upon a new form of polariscope, designed by Prof. A. M. Mayer, consisting of a special arrangement of crossed lenses, resulting in unusually good illumination and large field.

The next paper was upon a heliostat designed by Prof. Mayer. In this connection Prof. Mayer called attention to the shortcomings of the various forms of heliostats, and especially those using only one mirror, pointing out, among other things, the useless width of mirrors on such heliostats, and illustrating what ought to be the dimensions of such a mirror. He also called attention to the great advantage of using sunlight for all optical experiments over any

form of electric light; for example, with a heliostat and condensing system he was able to project the interference bands of the Fresnel bi-prism upon a screen so that they were visible across a large room. Prof. Mayer's heliostat consists in a clockwork driving a shaft parallel to the earth's axis; upon the southern end of the shaft is the mirror that can either be twisted on the shaft or set at any angle to the shaft. The second mirror is mounted upon the base with its central point in the prolongation of the shaft. To orient the heliostat it is only necessary to bring the side pieces in the north and south line and then set the mirror on the clock axis. This last is done by covering the elliptical mirror with a paper having a $\frac{1}{2}$ -inch hole in the center, and adjusting the tilting mirror until the small beam of light reflected from the mirror through the hole falls upon the center of the mirror attached to the base of the instrument; then starting the clock, the instrument will keep the beam in a constant direction. Prof. Hallock in discussing the paper called attention to the accuracy with which the heliostat operated, and related his experience with a very large one-mirror heliostat in the Smithsonian Institution at Washington, which, however, was thoroughly unsatisfactory. Prof. Woodward and Prof. Jacobi also entered into the discussion of the relative merits of the various heliostats, especially the typical one-mirror and two-mirror heliostats.

Prof. M. I. Pupin then brought before the academy some recent observations he had made while experimenting with X-rays. In the first place, he pointed out that certain Crooke's tubes after a certain amount of use had their vacuum improved, so that the induction spark passed outside the tube rather than through the tube. Prof. Pupin was at a loss to altogether explain the cause, but believed that it might be due to the condensation of some of the gas remaining in the tube, and explained several experiments which he had already made confirming the observation that the vacuum was improved with use, and that in proportion as the vacuum improved the tubes were better for X-ray photography. Another phenomenon observed by him was that in developing the photographic plates the development began at the glass side

of the film, leading to the inference that the X-rays penetrated the film and rendered the glass fluorescent, this fluorescent light then acting upon the film. Following the suggestion of this observation he painted the inside of a box with the platinum-barium-cyanide and laid a photographic plate against it, making a photograph then through the side of the box. The X-rays develop the fluorescence in the cyanide which fluorescent light affects the plate. In this way he obtained very good results with much shorter exposures than by the original method.

W. HALLOCK,
Secretary of Section.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held February 19th, thirty persons present. Mr. A. W. Grabau showed a specimen of the broad variety of *Paradoxides harlani* Green from a third locality in South Braintree.

Prof. A. Hyatt called attention to several shadowgraphs taken in Germany by Mr. R. W. Wood. One of them shows plainly the bones, the position and outline of the lungs, heart and cesophagus of a mouse, and indicates the possibilities of the ray as an aid to natural history studies.

Mr. Outram Bangs read a paper on the terrapin (*Malaclemys terrapin* Schoeff) as an inhabitant of Massachusetts. This species has been known for fifteen years as occurring in the creeks and salt marshes of Buzzard's Bay. It was formerly very abundant, but has lately become quite scarce. A comparison of the Buzzard's Bay material with a series from the Atlantic coast from Washington to Florida and from Mobile shows variations in color, marking, roughness of the shell, and in the size and shape of the skull. These variations, however, are not considered sufficient to form a separate race. The evidence that the terrapin is not native to Buzzard's Bay, but was introduced, was considered insufficient.

Dr. Joseph Lincoln Goodale spoke on the vocal sounds of animals and the mechanism of their production. He described the simplest type of larynx; also the four principal types, mentioning the best examples of each type. The three characteristics of sound were noted,

and the production and development of voice in man and in mammals described. The vocal cords and the glottis in birds were described, and the control, regulation and volume of voice mentioned.

Mr. C. J. Maynard, in commenting on Dr. Goodale's remarks, described the tympaniform membrane of birds, and mentioned that in the wild goose the whole bronchial tube formed one vibrating membrane. SAMUEL HENSHAW,

Secretary.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, MARCH 3, 1896.

MESSRS. MORRIS E. LEEDS and J. S. Stokes on behalf of Messrs. Queen & Co. made communications on the historical development of studies in connection with Röntgen photography, presenting the most advanced views regarding the nature of the X-rays as published by various investigators. They also exhibited a series of fine pictures illustrating the application of the process to the study of biology and the results obtained by the use of quick and slow plates and various developers.

Dr. Egbert having alluded to the results obtained by him from the direct rays of the sun through platinum plates, Mr. Leeds called attention to the desirability of experimenting with the sun's rays reflected from a mirror. If a positive result be obtained it would demonstrate either that it is incorrect to say that the rays cannot be reflected, or those producing Dr. Egbert's effects are not Röntgen rays.

Mr. Joseph Willcox presented a collection of 308 recent and fossil Fulgurs from various localities and geological horizons, illustrating with extraordinary completeness the evolution of the form.

A preliminary announcement was made of the presentation, by Dr. A. Donaldson Smith, of fine collections of mammals, birds, reptiles and insects made by him during his recent exploration of western Somali Land, Africa.

EDW. J. NOLAN,

Recording Secretary.

NORTHWESTERN UNIVERSITY SCIENCE CLUB.

At the meeting of February 7th Dr. Marcy in chair and thirty-three persons present, Dr. W.

A. Phillips presented a study of flaking refuse, based upon an extensive series of flakes and flaked cobblestones from sites of working, near Benton, Lake county, Illinois. The series offers several hundred outer flakes of which over two hundred are used flakes, assignable to six distinct uses from the character of the wear at edge or surface. Outer flakes are greatly in excess of other flakes in the refuse.

A large number of flaked cobblestones and of unused flakes, smaller, but still from the outside of the stone were treated as waste, nuclei and failures respectively. Specializations of the flake for hafting principally are represented, while further shaping of the cobblestone is wanting in a finished product. It is, however, represented in a limited series of rejects, indicating sporadic use of the nuclei. The rocks here used were diabase, found in the beach gravels of Lake Michigan, near sites. The nature and form of flake was due to the shape of the cobblestone. The operation used in producing the flake and illustrated by experimental results was referred directly to the hammerstone; the stone in the hand yielding the flake, the stone struck resting on the ground and serving only for the necessary percussion. A large number of lantern slides were used in illustration. Microscopic sections of rock from which the flakes came, prepared by Mr. Stebbins under Prof. Crook's direction, were exhibited.

A. R. CROOK,

EVANSTON, ILL.

Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of March 2, 22 persons present, Mr. F. W. Duenckel presented a comparison of the records of the United States Meteorological Observatory, located on the Government building in the city, with the record for the Forest Park station, showing that the daily minimum averaged decidedly lower at the Forest Park station than in the city, while the wind averaged decidedly higher for the city station.

Prof. E. A. Engler spoke on the summation of certain series of numbers.

WILLIAM TRELEASE,

Recording Secretary.